Docket No.: 20140-00281-US
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Patent Application of:
Timothy S. Chamberlain et al.

Application No.: 09/819,787 Confirmation No.: 6572

Filed: March 28, 2001 Art Unit: 1765

For: SLURRY AND USE THEREOF FOR POLISHING Examiner: S. Ahmed

APPELLANT'S BRIEF

MS Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

This brief is in furtherance of the Notice of Appeal, filed in this case on May 3, 2004.

I. REAL PARTY IN INTEREST

The real party in interest for this appeal is:

International Business Machines Corporation

II. RELATED APPEALS AND INTERFERENCES

The appeal in application No. 09/122,015 may directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

III. STATUS OF CLAIMS

Claims 1-39 are in the application. Claims 19-31 and 33-39 are pending and are on appeal. Claims 1-18 and 32 have been cancelled.

IV. STATUS OF AMENDMENTS

The amendments to the claims filed after the final rejection on March 23, 2004 has been entered.

V. SUMMARY OF INVENTION

The present claims relate to a method for polishing surfaces and particularly for polishing both metal and dielectric material at substantially the same polishing rate (see page 1, lines 3-9 of the specification).

The slurry composition employed in the method comprises abrasive particles and an oxidizing agent having a static etch rate on metal of less than 100 Å per hour and a pH of about 5 to about 11 (see page 3, lines 25-29; page 5, line 18 and page 6, lines 2-3).

VI. ISSUES

A. Has the Examiner established that claims 19-24, 26-27, 32-33 and 37-38 are anticipated under 35 U.S.C. 102(b) over U.S. Patent 5,770,103 to Wang et al.?

B. Has the Examiner established that claims 1-25, 28-31, 34-36 and 39 are anticipated under 35 U.S.C. 102(b) over U.S. Patent 5,804,513 to Sakatani et al.?

VII. GROUPING OF CLAIMS

With respect to each rejection of the claims, the involved claims stand or fall together.

VIII. APPELLANT'S ARGUMENTS

A. Wang Fails to Anticipate Claims 19-24, 26-27, 32-33 and 37-38.

Claims 19-24, 26-27, 32-33 and 37-38 were rejected under 35 U.S.C. § 102(b) as being unpatentable under U.S. Patent 5,770,103 to Wang, *et al.* (hereinafter also referred to as "Wang"). Wang does not anticipate the present invention. By way of background, the present invention relates to a method for polishing a surface and especially those surfaces employed in microelectronics. The method of the present invention employs a slurry composition that is capable of polishing both metal and silicon dioxide at substantially equal rates (see page 1, lines 7-9). The slurry compositions employed in the method of the present invention comprise abrasive particles and an oxidizing agent having a static etch rate on metal of less than 1000 Å per hour and having a pH of about 5 to about 11.

As discussed in the specification, the present invention provides a method that is capable of removing the topography and scratches created during the polish of a prior level of metallization.

In the manufacture of a semiconductor device, the wires for the chip in the "back end of the line" (BEOL) are usually formed by the so-called cloisonné process. In this process, the metal is uniformly deposited on the wafer, patterned with a mask, and then etched with a plasma reactive ion etch (RIE) tool to leave the metal isolated in regions where one desires the wires. Then the dielectric material is deposited, and polished using chemical mechanical planarization (CMP) to leave the conductors properly separated. One of the benefits of this process of forming the wires is that since the plasma RIE removes material on a "line of site", it is affective in removing the metal that might be deposited in topography that originated from a process operation at a prior level.

However, to both reduce cost and to utilize different, low-resistance materials for the construction of the metal wires, the cloisonné process is being replaced by the damascene

process to form the wires in the BEOL. In this reverse process, the dielectric is first uniformly deposited, patterned with a mask and etched. Then the metal conductor is uniformly deposited such that it forms a conformal film over the entire wafer and fills the patterns that have been etched into the dielectric. Then, using CMP, the excess surface metal is removed to leave the wires filled with metal. One of the problems with this process is since the metal is removed via CMP, which planarizes as it removes the excess material, residual metal can remain in topography that has been created at prior levels. That is, if there is a scratch or erosion in the dielectric, the metal will fill that void and cannot be removed easily via CMP without considerable over polish and the resulting damage that it introduces.

A specific example where this change in methodology of creating the wires is necessary is the manufacture of semiconductor devices with copper BEOL wiring. Since there is no viable process for etching copper currently available, it is a preferred technique to form the lines with the damascene process. In such a case, the local wiring of the semiconductor devices (that is at the lowest levels of the chip), usually utilizes tungsten as the conductor, which is then connected to the more global wiring in the BEOL, which is made of copper. In this specific example, it is found that erosion or scratching of the oxide dielectric at the last tungsten level replicates up and to the ensuing copper levels. The areas of erosion then lead to "puddles" of residual copper, and the scratches leave "stringers" of the copper, each of which if not removed at the copper CMP step would cause short-circuits. If these puddles or stringers are removed during the copper CMP step, it adds considerable processing time for the "overpolish."

Since the removal of all of the surface metal is essential to eliminate the short circuits and because the damascene process is sensitive to both the material and underlying topography of those materials, it is clear that the surface of the wafer must be highly planar (i.e., no existing topography) prior to the deposition of the metal. The obvious method of achieving this polarity is to polish the dielectric into which the metal will be inlaid to create a smooth, scratch-free film prior to metal deposition. However, this has the disadvantage that it would necessitate additional process steps (polishing and cleaning) and would result in a highly variable dielectric, and hence, conductor thickness. This would cause the undesirable result of having a variable resistance for the circuit.

The present invention overcomes problems in the prior art. More particularly, as discussed above, the present invention employs a slurry composition that is capable of removing the topography and scratches created during the polish of a prior level metallization. The slurry composition employed according to the present invention, as discussed above, can polish both metal and silicon at equal or substantially equal rates.

Wang fails to anticipate the present invention, since among other things, Wang fails to suggest selecting a pH of about 5 to about 11 along with selecting an oxidizing agent having a static etch rate on metal of less than 1000 Å per hour. On the other hand, Wang suggests employing a slurry having a pH of 1 to about 7 and employing an oxidizing agent such as nitrates, iodates, chlorates, perchlorates, chlorites, sulphates, persulphates, peroxides, ozonated water and oxygenated water. Many of these oxidizing agents exhibit etch rates significantly greater than that recited in the claims. Moreover, none of the examples in Wang employ a slurry composition having a pH of at least about 5 along with an oxidizing agent having a static etch rate or metal of less than 1,000 Å per hour. It has been found according to the present invention that both the pH and type of oxidizing agent, are judiciously selected in order to achieve the results obtainable by the present invention and namely to obtain polishing of both metal and silicon dioxide at equal or substantially equal rates.

On the other hand, the polishing compositions and technique suggested by Wang result in achieving much higher metal etching rates. For instance, Wang has polishing rates of nearly 4000 Å/minute (calculated from their film stack divided by polish time in example 1 and 2) which is obtained by having a high chemical component of the slurry, which is true for the pH range discussed in the examples (<5).

Contrary to the objectives of Wang, the purpose of the slurry used in the present invention is to keep the W rate low, and to make the W:BPSG selectivity = 1, by adjusting the pH higher than other slurries. According to the present invention, the pH is between 5 and 11 to make the selectivity equal or substantially equal. Needless to say, the tungsten polishing rate according to the present invention is also a factor of about 20 less than that desired by Wang

The objective of Wang is to achieve very high polishing rates for metal as contrasted to

the results obtainable by the present invention. The objective of Wang is to provide a slurry for removing titanium and other metals while suppressing the rate of removal of silicon (for instance, see column 3, lines 1-7 thereof). To etch metal and silicon dioxide at substantially the same rate would be contrary to the desires of Wang.

In addition, the claims now recite "polishing both metal and dielectric material at substantially the same polishing rate" from prior claim 32, which as recognized by the Examiner is not taught by Wang. Moreover, as discussed above this effect would be contrary to the objectives of Wang. Concerning this recitation, the Examiner in the Advisory Action states that it contradicts claim 33 which requires that the polishing rates of the metal is at least 50% of the dielectric material. This criticism is flawed since it is entirely proper for applicant to be his or her lexicographer and to define terms in the specification. See *Digital Biometrics, Inc. v. Identix, Inc.*, 149 F.3d 1335, 47 USPQ2d 1418 (Fed. Cir.1998).

Furthermore, the process constituents such as the abrasive and the oxidizing agent used by Wang, *et al.* are not identical to those claimed since nothing in Wang leads to employing a composition having the same abrasive, oxidizing agent, and pH as recited in the present claims from all of the possible combinations included within the suggestions of Wang.

It seems that this rejection is based on the assumption that the chemistry of the slurries of Wang and the present invention are similar enough to presume the static etch rates are likewise similar. Such a presumption is in error and at best merely speculative (and quite often wrong) because of the presence of particles in a slurry. When dealing with slurries, the situation is more complex. For instance, it is known that slurries, with their large surface area for adsorption, behave very unpredictably and differently and specifically are very sensitive to pH and the material properties of the abrasive. It is also well known that the surface charge tends to drive this difference. It is know that the iso-electric point can be quite different between particles--even particles that are manufactured via different means. (For example, see GA Parks, Isoelectric Point of Solid Oxides, Chemical Reviews, 1965 pp 177-198, Exhibit A, previously submitted). In fact, Wang's description states this effect explicitly, when discussing the complexation of various salts and organics to SiO_2 to affect polishing rate (Column 2, line 42-65 and Column 3, line 5).

Wang fails to anticipate the present invention. In particular, anticipation requires the disclosure, in a prior art reference, of each and every recitation as set forth in the claims. See Titanium Metals Corp. v. Banner, 227 USPQ 773 (Fed. Cir. 1985), Orthokinetics, Inc. v. Safety Travel Chairs, Inc., 1 USPQ2d 1081 (Fed. Cir. 1986), and Akzo N.V. v. U.S. International Trade Commissioner, 1 USPQ2d 1241 (Fed.Cir.1986).

There must be no difference between the claimed invention and reference disclosure for an anticipation rejection under 35 U.S.C. 102. See Scripps Clinic and Research Foundation v. Genetech, Inc., 18 USPQ2d 1001 (CAFC 1991) and Studiengesellschaft Kohle GmbH v. Dart Industries, 220 USPQ 841 (CAFC 1984).

Also, Wang lacks the necessary direction or incentive to those or ordinary skill in the art to render a rejection of the claims under 35 USC 103 sustainable. Wang fails to provide the degree of predictability of success of achieving the properties attainable by the present invention needed to sustain a rejection under 35 USC 103. See Diversitech Corp. v. Century Steps, Inc. 7 USPQ2d 1315 (Fed. Cir. 1988), In re Mercier, 187 USPQ 774 (CCPA 1975) and In re Naylor, 152 USPQ 106 (CCPA 1966).

Moreover, the properties of the subject matter and improvements which are inherent in the claimed subject matter and disclosed in the specification are to be considered when evaluating the question of obviousness under 35 USC 103. See Gillette Co. v. S.C. Johnson & Son, Inc., 16 USPQ2d. 1923 (Fed. Cir. 1990), In re Antonie, 195, USPQ 6 (CCPA 1977), In re Estes, 164 USPQ (CCPA 1970), and In re Papesch, 137 USPQ 43 (CCPA 1963).

No property can be ignored in determining patentability and comparing the claimed invention to the cited art. Along these lines, see In re Papesch, supra, In re Burt et al, 148 USPQ 548 (CCPA 1966), In re Ward, 141 USPQ 227 (CCPA 1964), and In re Cescon, 177 USPQ 264 (CCPA 1973).

Furthermore, the law is well settled that claiming of a more specific range within a more generic range and/or claiming species from a broader group of possible compounds avoids the invention from being exactly the same as the prior art. The test employed is whether the claims

read on the prior art disclosure, not on what the references broadly teach.

For example, see *Akzo N.V. v U.S International Trade Commissioner*, 1 USPQ2d. 1241 (Fed. Cir. 1986). In *Akzo*, claims that were drawn to a process for making aramid fibers using a 98% sulphuric acid were not anticipated by reference using a concentrated sulfuric solution but which did not specifically disclose that it was a 98% concentrated sulfuric acid solution.

The Court further found that no anticipation exists when one would have to "randomly pick and choose a number of different polyamides, a plurality of solvents and a range of inherent viscosities" to reach the claimed invention.

In *Rem-Cru Titanium v. Watson*, 112 USPQ 88 (D.D.C.-1956), the prior art showed alloys having broad ranges which included the claimed ranges. However, the prior art did not specifically disclose the more limited claimed ranges or alloys having the characteristics of the claimed alloy, which is analogous to the present case. Accordingly, the Court held the claims to be allowable. For a similar fact pattern and same holding, please see *Becket v. Coe* (CA, DC 1938) 38 USPQ2 and *Terak v. Watson* (DC-DC 1954) 103 USPQ78. Also, see *Minnesota Mining & Manufacturing Co. v. Johnson & Johnson Ortho-Paedics, Inc.* (24 USPQ2d, 1321 Fed. Cir. 1992). Here the Court held that although the claims may be subsumed in a prior art reference generalized disclosure, this is not literal identity. The reference ranges provided no guidelines on how to construct a product with the inventions attributes.

An invention cannot be rejected based on inherency because of probability or possibilities of the presences of the constituents in the prior art. *See Crown Operations International, Ltd. v. Solutia*, 24 USPQ2d 1917 (Fed. Cir. 2002).

Also, Wang is to be considered as a whole, and portions arguing against or teaching away from the claimed invention must be considered. See *Bausch & Lomb, Inc. v. Barnes-Hined/Hydrocurve, Inc.* 230 USPQ 46 (Fed. Cir. 1986). It is improper to take portions of a disclosure out of their proper contect. See *Bausch & Lomb, Inc. v. Barnes-Hind/Hydrocurve, Inc.*, supra.

B. Sakatani Fails to Anticipate Claims 19-25, 28-31, 34-36 and 39

The rejection of Claims 19-25, 28-31, 34-36 and 39 rejected under 35 U.S.C. § 102(e) as being anticipated by over U.S. Patent 5,804,518 to Sakatani, *et al.* (referred to herein as "Sakatani") has been overcome by the above amendment to claim 19 to include recitations from prior claim 32. Claim 32 was not rejected over Sakatani.

CONCLUSION

In view of the above, it is abundantly clear that the Primary Examiner erred in finally rejecting claims 19-31 and 33-39. It is therefore respectfully requested that the Bard reverse the Examiner and allow claims 19-31 and 33-39.

The director is hereby authorized to charge any fees, or credit any overpayment, associated with this communication, including any extension fees, to Deposit Account No. 50-0510.

Dated: June 17, 2004

Respectfully submitted,

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APPENDIX A

Claims on Appeal

19. A method for polishing both metal and dielectric material at substantially the same polishing rate, comprising:

providing on said metal and dielectric material a slurry comprising abrasive particles and an oxidizing agent wherein said oxidizing agent has a static etch rate on metal of less than 1000Å per hour; and wherein the pH of the slurry is about 5 to about 11;

and polishing said metal and dielectric material by contacting it with a polishing pad.

20. The method of claim 19 wherein said oxidizing agent is present in the composition in amounts of about 1 g/L to about 100 g/L.

21. The method of claim 19 wherein said abrasive particles are present in the composition in amounts of about 0.2 to about 30% by weight.

22. The method of claim 19 wherein said oxidizing agent is selected from the group consisting of potassium iodate, sodium iodate and ammonium cerium nitrate, and potassium ferricyanide.

23. The method of claim 19 wherein said oxidizing agent comprises potassium iodate.

24. The method of claim 19 wherein said abrasive particles are selected from the group consisting of alumina, silica, zirconia, ceria, titanium dioxide, ferric oxide and mixtures thereof.

25. The method of claim 19 wherein said abrasive particles have a particle size of about 10 to about 1000 nanometers.

26. The method of claim 19 wherein said abrasive particles include silica.

27. The method of claim 19 wherein said slurry is an aqueous slurry.

28. The method of claim 27 wherein said slurry further contains an organic diluent.

29. The method of claim 28 wherein said organic diluent is selected from the group consisting of propylene carbonate, methanol, ethanol, ethylene glycol, glycerol and mixtures thereof.

30. The method of claim 19 wherein said slurry contains an organic diluent.

31. The method of claim 30 wherein said organic diluent is selected from the group consisting of propylene carbonate, methanol, ethanol, ethylene glycol, glycerol and mixtures thereof.

33. The method of claim 19 wherein the ratio of polishing rates of said metal to said dielectric material is about 1:2 to about 2:1.

34. The method of claim 19 wherein said polishing involves the step of metal CMP which immediately precedes deposition of the next level dielectric for the purpose of removing scratches or reducing the effects of erosion on dense contact pattern areas or both.

35. The method of claim 19 wherein said polishing comprises removing an adhesion promoting or diffusion barrier layer.

36. The method of claim 35 wherein said adhesion promoting or diffusion barrier layer is at least one material selected from the group consisting of titanium, titanium nitride, tantalum and tantalum nitride.

37. The method of claim 33 wherein said metal is selected from the group consisting of aluminum, copper and tungsten and said dielectric is silicon dioxide.

38. The method of claim 19 wherein the speed of said pad during said polishing is about 10 to about 150 rpm, and the speed of the wafer carrier is about 10 to about 150 rpm.

39. The method of claim 25 wherein said abrasive particles include silica.